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DISCOVERY

Nexus of international reserve and public debt in Ghana

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This paper assesses the effects of public debt on international reserve in Ghana using data from 1960 to 2015. To achieve the set objectives, the research employed secondary data sourced from the International Monetary Fund (IMF)'s World Economic Outlook (WEO), published in October 2016, World Bank, International Comparison Programme database and the Central Bank of Ghana database. Data was analysed with the support of Johansen cointegration, Granger causality and fully modified OLS using Stata and jMulTi. The empirical results indicate that public debt has a positive and significant effect on external reserve stock, both in the short and in the long run, suggesting that Ghana's debt crisis can be attributed to both exogenous and endogenous factors; however, nominal effective exchange rate shows to have weaker linkage to external reserves. This paper provides empirical implications for Ghanato adopt fixed interest payments and sufficient rescheduling period to avoid the use of international reserve to correct debt imbalances.

INTRODUCTION

Infrastructural need for electricity generation and distribution, roads constructions, and acquisition of airports and ports has led to a high demand for resources by the majority of sub-Saharan African countries. Resources required by developing countries to invest in the various projects when properly financed will have a significant impact on both short and long-term growth. Again, proper management of financial resource will ensure sustainability of the debts of many sub-Saharan African countries which Ghana is not excluded. Some developing countries though have good developmental plans, but have fewer opportunities and sources of financing compared with other countries in the world. With the exception of only few countries, internally generated funds and domestic debt markets are not sufficiently developed to take care of their developmental financial needs. Sometimes, the means that can pave way to raise resources are constrained by the limited amount of savings, unfavourable balance of trade and exchange rate (IFS, 2015).

Debt trend in most developing countries in Sub-Sahara Africa continue to increase. Statistics indicate that, the total external debt stock in Africa reached US$313.2 billion in 2012 as debt continued to grow by 6.4 per cent per annum between 2000-2008 and 2012. Though by relativity, the 6.4% is at a slower pace compared to the growth recorded in 2011 (9%), (IFS, 2015). The debt ratios of most countries in Africa are estimated to have worsened in 2012 after a slight improvement in 2008. Based on GDP from 2011 to 2012, the continental debt to the respective GDP increased from 20.7 percent to 22 percent; debt service to exports experienced a rise from 7.9 percent to 8.5 percent; and also, an increase in the ratio of total debts to exports from 68.3 percent to 75.2 percent within that same period. According to UN (2013), international reserves for all the developing countries between the year 2000 and 2008 stood at US$1.9 trillion. With no reason, the international reserves increased to US$6.3 trillion in 2012.

The history of Ghana with regards to the external debt and total public debt stock is not different from Sub-Sahara Africa, as the country's total debt stock rose substantially after the 2005-06 debt relief. The continues increase in Ghana`s debt stock is indicating a rise in risks to debt sustainability, particularly at the period of economic crises. In 2006 – 2008, Ghana adopted a highly expansionary fiscal policy which was financed by external borrowing to ensure rapid development in the country. However, the borrowing rather triggered a very rapid deterioration in the country's debt sustainability and worsened the growth of the economy (IMF, 2013). The country`s situation was worsened by unfavourable export and import commodities prices, the resulting balance of payments pressures and currency depreciation which negatively impacted on the economy leading to a revaluation of foreign currency-denominated claims relative to domestic GDP in Ghana. Ghana`s debt surge was efficiently and effectively stemmed when the country's access to market financing was closed off making it difficult for Ghana to borrow and remedy the situation in 2008 due to the global financial crisis that inversely affected most borrowing countries.

Statistic from the Institute for Fiscal Studies (IFS) shows that Ghana's public debt stood at US$8.1 billion at the end of 2008, which was equivalent to 34.8 percent of GDP by calculation. Again, the International Monetary Fund (IMF)'s World Economic Outlook (WEO) (October 2016) shows that, Ghana's total debt stock stood at 25.6 billion dollars which represent 43.3 percent of GDP. The IMF figure reflected larger than previously assumed fiscal deficit in 2008 (34.8 percent of

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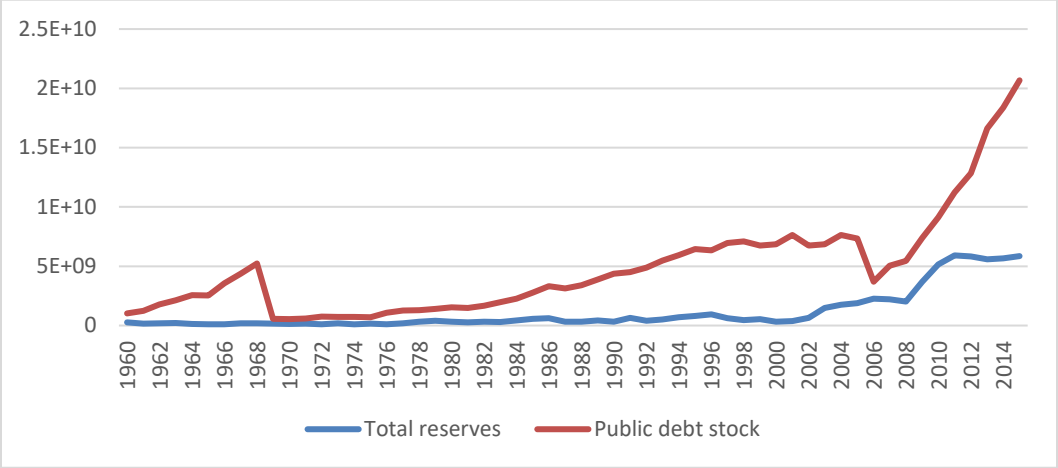

Source: Authors` sketch, 2017

Figure 1 Trend of Public Debt and International Reserve in Ghana

GDP, or 4 percentage points higher than previously projected) and also reflected the impact of the currency depreciation on the foreign debt-to-GDP ratio in Ghana. In 2008, public sector external and domestic debts were almost equal in size with each close to US$4 billion representing 17.4 percent of the country's GDP (MIS, 2014; Ministry of Finance, 2012). External debt rose rapidly from 10.7 percent in 2006 to 17.4 percent of GDP in 2008, reflecting the US$750 million Eurobond issued at the end of 2007, together with new concessional bilateral financing and loans contracted from the IDA over the period following the Multilateral Debt Relief Initiative (MDRI) to Ghana. Relating the debt history of Ghana to the international reserves, like Sub-Sahara, Ghana`s international reserves is positively related to the country`s total debt stock. The graph below shows the trend of Ghana`s total debt stock and the corresponding international reserves from the year 1960 to the year 2015 (Figure 1).

According to Ajibola et al. (2015), external debt refers to unfulfilled portion of foreign resources acquired for developmental purposes and balance of payment support from international institutions which are not repaid as they fall due or the agreement time lapses. External debt comprises of debt owed by a country to other countries or institutions abroad which consist of regulating of payment imbalances through intervention in the exchange markets, direct financing and official public sector foreign assets that are readily available to and controlled by the monetary authorities or foreign government (IMF, 2003).

Public debt's influence on external reserves has been theoretically examined by researchers, and this cannot be overemphasised since the principle is that, external debts have to be settled in foreign currency and the first hand money resource which by its nature is foreign currency is the stocks of international reserves, hence, international reserves become a significant source of financing external imbalances and foreign exchange market intervention so as to guide against unforeseen volatility and prevent future restriction of borrowing. As a deliberate policy by some research, public debt has been seen as one of the ways in which developing countries can complement their low capital stock given their high marginal returns on capital and necessity of project to implement. In Ghana, the public debts have not yielded its desired result due to poor implementation of monetary policies, corruption and fiscal indiscipline and lack of accountability by the management of funds in the country leading to a continues plan of budget deficit in the country (Adeniran Adetayo, 2018). This negative practice resulted in the non-sustainability of the country's public debt and depletion of external reserve by government to finance persistent deficit budget which further compound the level of jobless and economic growth in the country, leading to debt servicing or debt re-scheduling. Kemal, (2002) and Friedman (1953) assert that, foreign exchange reserves are insignificant and others argue that reserve holding is necessary to help smoothen balance of payments imbalances. Hur and Kondo (2011) and Zhou (2015) also declared in their research that, studies conducted on external reserves were much focused on reserve accumulation and utilization. Also, much attention was given to the demand for international reserves, the impact of reserve holding, implications for investment, inflation, and so on, without assessing the plausible interplay between public debt and international reserve of Ghana. This implies that the role of public debt as a determinant of international reserve has been downplayed. To close the research gap, this study examined both the short and long run relationship between public debt and international reserves, found the causal relation and assessed the statistical parameters of the possible factors that influence international reserves in Ghana.

METHODOLOGY

This research has adopted econometric technique to examine the relationship between Ghana's international or external reserve and public debt taking into account other associated variables. Trend of graph gives descriptive pattern of public debt and external reserve that Ghana experienced from 1960 to 2015 thus explaining the behaviour of both variables. This research also provides a sustainability policy that Ghana engaged in a longer period and the policy effects on the performance of the Ghana foreign reserve. Economic Recovery and Structural Adjustment Program (SAP) were adopted in 1983 and 1984 respectively, as a remedy of addressing the weaknesses and ineffectiveness of outmoded development planning and exceeded demand for revenue resulting in unchecked external borrowing, however, the policies do not perform up to expectation. Hence, the need to find the connection and causal relationship between international reserves and public debt using econometric methods of Augmented Dickey Fuller, Philip Peron (PP) and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) Stationary test, Johansen co-integration, Granger Causality test and Fully Modified Ordinary Least Square (FMOLS)

Data Set

The research employed secondary data sourced from International Monetary Fund (IMF)'s World Economic Outlook (WEO), published in

October 2016, World Bank, International Comparison Programme database and the Central Bank of Ghana database. As external reserve and public debt were reported on international database, they were measured in international currency of (US dollar) while broad money supply and nominal effective exchange rate were drafted in national database, hence were measured in Ghana cedi. To ensure interpretation of the results in percentage change and elasticity as well as overcome the discrepancies in the currencies connected to the variables, the money supply and effective nominal exchange rate were converted to US dollar using the current conversion rate and all the variables were logged and interpreted with respect to their elasticity.

Theoretical Framework

Test for Stationary

The research dwelled on establishing the relation between international reserve and public debt in Ghana through the adoption of co-integration and granger causality. Prior to the test of co-integration, appropriate stationarity models are applied. The first step in this study is to investigate the integration properties of international reserve, public debt, broad money supply and effective nominal exchange rate. This is to ensure that, the variables are integrated (non-stationary) and also know the level or degree the variables are integrated. When the condition of all variables in the data are integrated of order one, *I (1)* is satisfied, the research can proceed to test whether the interested variables in this case international reserve, public debt, broad money supply and effective nominal exchange rate are co-integrated using Johansen methodology. Data with time span is proved to be stationary if the data has constant mean and variance over the period given.

It is critical to test data that is series by time in nature to know whether it is stationary or not, as a non- stationary time series behaviour can influence the results falsely for the period under consideration making the time series to have little if not no practical value on the results, especially in forecasting purposes. Also, estimating two or more non-stationary time series variables in regression analysis may lead to spurious outcomes– the R^2 will be characterised by a high value, and some or the entire regression parameters or estimated coefficients may be statistically significant on the basis of t and F tests which may not be reliable or accurate (Gujarati, 2012). With the stated reasons above, it is critical to test time series stationarity before taking co-integration test. The stationarity can be tested using graphical analysis, autocorrelation function and correlogram as well as unit root test. However, the research dwelled on the unit root test of stationarity to verify the otherwise of the data.

According to Lavan and Paul (2004), unit root test is considered as an appropriate technique in testing for stationarity as it aids in model building. Furthermore, identification of series that has a unit root can be correct as the series can be differenced to render it stationary. Literature shows that, knowing significant difference between a trended series and a difference-stationary series may be extremely difficult to see in small samples.

The test for unit root test was performed on single time series of each variable to increase precision. The unit root test for the pair of variable for Dickey-Fuller test can be expressed below:

$$\Delta Y_t = \beta_1 + \beta_{2t} + \beta_3 Y_{t-1} + \mu_t \quad \ldots\ldots\ldots (1)$$

Where $\Delta Y_t = Y_t - Y_{t-1}$, that is, the first difference of the pair of variables, β_1 is the drift, subscript t is the time taking the value of 1, 2, till the end of the sample and μ_t is the error term.

Taking the regression of the first difference of the pair of each variable (international reserve, public debt, money supply and effective nominal exchange rate) on the time variable and the one-period lagged value of the same variable. Hypothesis for the DF test is: The null hypothesis is that β_3, the coefficient of Y_{t-1} is zero. This is usually known as the unit root hypothesis (non-research hypothesis). The alternative hypothesis is that $\beta_3 < 0$; that is, the time series is stationary (no unit root). The refusal to reject the null hypothesis would suggest that the time series under consideration is non-stationary; hence, there is unit root in the series. Equation (1) in a practical sense is estimated with the help of OLS and the calculated t-value of the coefficient of the Y_{t-1} is compared with the DF critical. If β_3 t-calculated is greater than the DF critical value, then, the null hypothesis is rejected which the conclusion will be that the time series under consideration is stationary.

Gujarati (2012) asserts that, the DF test can be performed in three different forms namely; the random walk absents of a drift, random walk with the present of a drift and random walk in which the drift is connected to a deterministic trend. If the time series fluctuates around a sample average of zero, the random walk without drift is appropriate, in the case of when the time series fluctuates around a sample average that is non-zero, random walk with drift is used, and for time series that fluctuates around a linear trend which some time the trend could be quadratic, it is advised that random walk with drift around a deterministic trend applied.

This research employed Augmented Dickey–Fuller (ADF) and Philip Peron (PP) tests to aid verify the null hypothesis which always says the series are not stationary and not the usual t-test which is identified to have weakness of only giving a valid result if the time series under study is stationary. In addition, Augmented Dickey-Fuller (ADF) model will be appropriate as the variables under consideration in this research are not stable at a given time and the error term usually correlates with the subsequent error term. The ADF test is conducted by "augmenting" the random walk without drift, random walk with drift and random walk with drift around a deterministic trend method through an addition of the lagged values of the dependent variable as shown below:

$$\Delta Y_t = \beta_1 + \beta_2 t + \beta_3 Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad \ldots. (2)$$

Where ε_t is a pure white noise error term, m is the maximum length of the lagged dependents variable and ΔY_{t-i} is change in variable of time t less i term. The number of lagged difference terms to include is usually arrived by empirical approach, the idea being to include enough terms so that the error term in equation (2) is serially uncorrelated. In ADF, the test is still on whether $\beta_3 = 0$ and the ADF test follows the same asymptotic distribution as the DF statistic, therefore, the same critical

values can be used. The Philip Peron test (1988) of unit root test was also employed. The regression equation for the PP test is given by

$$\Delta Y_t = \alpha + \phi Y_{t-1} + \varepsilon_t \quad \text{..... (3)}$$

The null hypothesis of non-stationarity or there is unit root against the alternative of stationarity or there is no unit root was tested for both the ADF and PP tests. However, an opposed test which also measures the stationarity of time series data is the KPSS test. The KPSS tests the null hypothesis of stationarity against the alternative of non-stationarity.

To confirm the ADF and PP test results, Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test for unit root was adopted. In econometrics analysis, Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests are used for testing a null hypothesis that an observable time series is stationary around a deterministic trend. Bhargava (1986) observed that, this current model was proposed in 1982 by Alok Bhargava in his Ph.D. thesis where several John von Neumann or Durbin–Watson type finite sample tests for unit roots were developed. Later, Denis Kwiatkowski, Peter C. B. Phillips, Peter Schmidt and Bhargava (1986) proposed a test of the null hypothesis that an observable series is trend stationary, thus, emphasis should be given to stationary around a deterministic trend rather than the ADF and PP. To Bhargava (1986), the measure model should be expressed as the sum of deterministic trend, random walk, and stationary error and the test should be a Lagrange multiplier test of the hypothesis that the random walk has zero variance. The idea resulted into KPSS test which intended to complement unit root tests, such as the Augmented Dickey–Fuller tests. Simultaneously testing both the unit root hypothesis and the stationarity hypothesis strengthens the verification method and one can distinguish series that appear to be stationary with ADF, but in real sense, the series have a unit root. Another key reason is that, series for which the data (or the tests) are not sufficiently informative to be sure whether they are stationary or integrated is easily verify.

Test of Co-integration

In establishing fact of linkage, taking regression of a unit root time series on another unit root time series is the starting point of testing for co-integration regardless of the case or variable series under consideration. When the four variables were integrated of the same order, thus, integrated by order one, the research proceeds to test for co-integration properties among the four variables and also carry causality examination between IR_t and PD_t *in* a co-integration and causality frame work.

Review of literature indicates several approaches that allow investigating the integration properties of two (or more) variables that are likely to have a long run relationship or association. Initial method researchers embarked on, which applied to investigating the existence or otherwise of co-integration relation between two variables was the Engle and Granger (1987) approach. The procedure contains the following two steps. Firstly, a regression equation below will be run

$$X_t = \beta Y_t + \mu_t \quad \text{..... (4)}$$

If the residuals, μ_t, are *I(0)*, then X_t and Y_t are said to be co-integrated. Then, Johansen and Juselius approach of testing for co-integration relationships, *r*, will be implemented since it allows for the presence of multiple co-integration relationships. The multiple relationship test considers the following basic vector auto regressive (VAR) model of order *p*:

$$Y_t = A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \mu_t \text{..... (5)}$$

Where $Y_t$is a vector of non-stationary variables, in this study a 4 ×1 vector containing the natural logarithm of annual figures of external reserve, money supply, effective nominal rate and public debt, *Ai* is a 4 ×4 matrix of parameters, and $\mu_t$is i.i.d. (independently and identically distributed) *k* dimensional Gaussian error term with $\mu_t \sim (0, \Sigma\mu)$. However, this co-integration method though simple to implement, has a list of weakness leading to the adoption of Johansen approach.

Analysis of cointegration in this research have chosen Johansen (1988) maximum likelihood estimators over Engle and Granger (1987) two-step procedure which is easy to use but has several important limitations and can, sometimes, provide misleading results. The Johansen approach circumvents the two-step procedure and can check for multiple cointegration vectors.

Johansen (1988) relies heavily on the relationship between the rank of a matrix and its characteristic roots. The Johansen procedure is a multivariate generalisation of the Dickey-Fuller test which shows by the formula:

$$\Delta Y_{it} = A_1 Y_{it-1} - Y_{it-1} + \varepsilon_t \quad \text{..... (6)}$$
$$\Delta Y_{it} = (A_1 - I) Y_{it-1} + \varepsilon_t$$
$$\Delta Y_{it} = \Pi Y_{it-1} + \varepsilon_t$$

Where Y_{it} and ε_t are (nx1) vectors; A_1 = an (n x n) matrix of parameters;

I = an (n x n) identity matrix; and $\Pi = (A_1 - I)$ matrix.

Rank of $(A_1 - I)$ matrix equals the number of cointegration vectors. The crucial thing to check is whether $(A_1 - I)$ consists of all zeroes or not. If it does, that implies all the $\{\Delta Y_{it}\}$ in the above VAR are unit root processes, and there is one linear combination of $\{Y_{it}\}$ which is stationary, and hence the variable is not cointegrated. The rank of matrix Π is equal to the number of independent cointegration vectors.

Evidence of the presence of cointegration relationship among the four-series occurred through the examination of Trace and Maximum Eigenvalue test. Employing the estimates of the characteristic roots, the test for the number of characteristic roots that are insignificantly different from unity was conducted using the following statistic:

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}) \quad \text{.... (7)}$$

Where $\hat{\lambda}$ = the estimated values of the characteristic roots (Eigen values) obtained from the estimated Π matrix; and *T* = the number of usable observations. The second statistical test is the maximum Eigenvalue test $(\lambda_{\max})$ that is calculated using the formula

$$\lambda_{\max}(r, r+1) = -T \ln\left(1 - \hat{\lambda}_{r+1}\right) \quad \text{... (8)}$$

The test of cointegration is based on the null hypothesis of no cointegration (H_0: r=0) against the alternative of at least one cointegration (H_A: r=1)

Testing for Granger Causality

With the understanding and logic that the existence of cointegration between two economic variables implies at least unidirectional Granger causality, the research extends the cointegration tests to test for Granger causality. The reason behind this causality is to verify whether government of Ghana external borrowing dynamic exhibits well-defined paths i.e. to know whether changes in the public debt of Ghana is influenced by the level of international or foreign reserve or the reverse is the case. In briefly explaining the Granger causality test, the study considered asking the usual macroeconomics question of: Is it international or external reserve of Ghana that "causes" Ghana`s public debt to change($IR_t \rightarrow PD_t$) or is that public debt of Ghana leads international or external reserve in the dynamic process ($PD_t \rightarrow IR_t$), in which the arrows give causality direction. Critical assumption of the Granger causality test is that the information relevant to the prediction of the respective macroeconomic variables is contained solely in the time series data on these variables. Granger-causality tests examines the degree to which both current and past international reserve changes explain current change in government debt pattern and also, how both current and past public debt fluctuation affects changes in current external reserves (Brüggemann, 2003). The test involves estimating the following pair of regressions:

$$IR_t = \sum_{i=1}^{n} \alpha_i PD_{t-i} + \sum_{i=1}^{n} \beta_j IR_{t-j} + \varepsilon_{1t} \quad \text{.... (9)}$$

$$PD_t = \sum_{i=1}^{n} \lambda_i PD_{t-i} + \sum_{i=1}^{n} \delta_j IR_{t-j} + \varepsilon_{2t} \quad \text{.... (10)}$$

Where the disturbances ε_{1t} and ε_{2t} are assumed to be uncorrelated.

Granger causality has possible four cases:

1. *Unidirectional causality from public debt at time t (PD_t) to international reserve at time t (IR_t)* is indicated if the estimated coefficients on the lagged PD_t in equation (9) are statistically different from zero as a group (i.e. $\sum \alpha_i \neq 0$) and the set of estimated coefficients on the lagged IR_t in equation (10) is not statistically different from zero (i.e. $\sum \delta_j = 0$).

2. Conversely, *unidirectional causality from international reserve at time t (IR_t) to public debt at time t (PD_t)* exists if the set of lagged PD_t coefficients in equation (9) is not statistically different from zero (i.e. $\sum \alpha_i = 0$) and the set of the lagged IR_t coefficients in equation (10) is statistically different from zero (i.e. $\sum \delta_j \neq 0$).

3. *Feedback*, or *bilateral causality*, is suggested when the sets of *international reserve at time t (PD_t)* and *public debt at time t (IR_t)* coefficients are statistically significantly different from zero in both regressions (i.e. $\sum \alpha_i \neq 0$ and $\sum \delta_j \neq 0$).

4. Finally, *independence or no causality* is suggested when the sets of *international reserve at time t (PD_t)* and *public debt at time t (IR_t)* coefficients are not statistically significant in both the regressions (i.e. $\sum \alpha_i = 0$ and $\sum \delta_j = 0$).

An appropriate step involved in implementing the Granger causality test to arrive at an accurate result is specified in equation (11). Estimation of restricted and unrestricted model for the two equations (equation 9 and 10), this is followed by the estimation of F-test given by

$$F = \frac{(RSS_R - RSS_{UR})/m}{(RSS_{UR})/(n-k)} \quad \text{.... (11)}$$

The F test follows the *F* distribution with *m* and (*n*− *k*) degrees of freedom. In the present case, *m* is equal to the number of lagged terms; *k* is the number of parameters estimated in the unrestricted regression, RSS_R is the residual sum of squares from the restricted model and RSS_{UR} is residual sum of squares from the unrestricted model. Since the study focused on two variables, this test of causality deals with bilateral causality. By explanation, Equation (9) postulates that current international reserve is related to past values of itself as well as that of public debt, and (10) postulates a similar behaviour for public debt.

A unidirectional Granger causality of $IR_t \rightarrow PD_t$ or $PD_t \rightarrow IR_t$ is proved by an F-test on the null hypothesis that the coefficients of PD_{t-i} in equation (9) and IR_{t-j} in equation (10) equal zero. i.e. $\alpha_i = \sigma_j = 0$, while the alternative hypothesis states that; at least one of the coefficients is not equal to zero. Passing decision is based on the value of the calculated and critical F. If critical F-value is less than the computed F value, we reject null hypothesis, explaining causal relationship.

Theory of Optimum Reserve Allocation

Analysis of public debt with respect to a link with an economic variable cannot exclude the theory of optimal reserves allocation (TORA) which functions in a situation where governments face rollover risk in the form of debt rescheduling or rearrangement of payment. The history of Ghana's public debt with the IMF and the World Bank exhibits the dominant character of debt rescheduling. The TORA model gives an extension to a dynamic framework by providing a theory for the increase in reserves. The theory explained that while interim reserves, interim liquidation, and the interest rate are functions of the aggregate liquidity shock, summation of the aggregate state and the individual liquidity shock of an investor results into the rollover policy. As stated by Senibi et al., (2016), debt contract is a means feasible to ensure that, initial reserves and invested capital cannot exceed the loan amount; and

Table I Descriptive Statistics of Series

Variables	IR	PD	NER	M2
Mean	75885468.21	1.27E+09	153.35	1,345,654.00
Std. Dev.	11467.67	45675.45	23.65	24,844.53
Min	115,809,200.00	1240000000.00	44.56	15,990.00
Max	5,854,000,000.00	20,700,000,000.00	866.15	37,516,940,000.00
Kurtosis	1.24464	2.4565	2.5321	1.3564
Skewness	0.5567	1.6537	0.0547	1.4788
Jarque-Bera	4.8379	3.4477	7.3843	9.3234
Sum	845400000000.00	3748000000000.00	1983.87	93,456,887,524.00
Observation	55	55	55	55

Source: Authors` computation, 2017

interim reserves and interim payments cannot overcome initial reserves and interim output of the investor. This simply suggests that the borrower in this case, the government, cannot lend the interim against the future output from the initial investment (borrowed money). Therefore, liquidation and reserves are the only resources available to make interim payments to the lender, usually, international lenders. The worst developing countries that need aid end up using their final output and residual reserves as the only resources available to make final payments which describe economic shrinking. TORA model suggests a condition which requires that the interim rollover policy is to reschedule the loan provided that, the rolling yield a higher payment than calling the loan in the interim by the investor.

Based on the significant condition covering the theory of optimal reserves allocation (TORA) model, this study adopted the model in analysing the relationship between government total borrowing and external reserves in Ghana taking in to account broad money supply and nominal effective exchange rate. Is critical to know that, external reserves which some time called international reserve usually denominated in foreign currencies (US dollar) and kept in banks in developed economies where they are managed and public debt comprised government borrowing from both domestic (internal sources) and international (external sources). The TORA model is stated as:

$$IR_t = F(PD_t, M2_t, NER_t) \quad \text{..... (12)}$$

Where IR stand for international reserves, PD stand for public debt, M2 stand for broad money supply and NER stand for nominal effective exchange rate. This research assumes a nonlinear model structured which in its explicit form is represent as:

$$IR_t = \psi..PD_t^{\alpha_1}..M2_t^{\alpha_2}..NER_t^{\alpha_3}.\mu_t \quad \text{... (13)}$$

Equation 13 will translate to equation 14 when double log

$$\log IR_t = \log \alpha_0 + \alpha_1 \log PD_t + \alpha_2 \log M2_t + \alpha_3 \log NER_t + \log \mu_t \quad \text{..... (14)}$$

Where α_0 is the intercept or constant, α_1, α_2 and α_3 are estimated parameters with prior expectation of; $<, < or > and <$ respectively, t is the time span of the data and , μ_t is the error term.

The TORA model in this research takes into account four variables; namely; public debt, broad money supply, nominal exchange rate and international reserve with the aim of explaining the influence on Ghana`s debt since 1960.

RESULTS AND DISCUSSION

Descriptive Statistics

Statistics by summary are used to describe the basic features of the data in this research. The descriptive statistics are presented in a raw data form and help us to simplify large amounts of data into sensible way as well as provide a powerful summary that may enable comparisons across units of measurement. The summary statistics of the four related variables are tabulated below. The Table I indicates the mean, standard deviation, minimum, maximum, kurtosis, skewness, sum and the number of observation of the series (International reserves, public debt, nominal effective exchange rate and money stock in supply) for Ghana for the period of 1960 to 2015.

Table I illustrates the statistical analysis of 55 observations of the variables IR, PD, NER and M2. It is observed that, the minimum and maximum annual international reserves of Ghana within the time range under consideration are 115,809,200 and 5,854,000,000.00, that of public debt are1,240,000,000.00 and 20,700,000,000.00 with nominal effective exchange rate and broad money supply been44.56 and 866.15 and 15,990 and 37,516,940,000 respectively. Also, the average (which is the sum of all the values in the data of a respective variable divided by the total number of observation) of IR, PD, NER and M2 are shown to be 75,885,468.21, 1,270,000,000.00, 153.35 and 1,345,654.00 respectively and the respective standard deviation (which is computed by taking square root of the variance) of IR, PD, NER and M2 is shown to be 11467.67, 45675.45, 23.65 and 24,844.53.

Table I again shows the degree of asymmetry of distribution for each series (Skewness). The skewness could be left-handed (negative) or right-handed skewed (positive). In this research, all the variables are positively skewed. Kurtosis which measures the degree to which the frequency distribution is focused about its mean is also presented and kurtosis could be positive, zero or negative in terms of its coefficient. From observation, all the variables exhibit leptokurtic kurtosis, thus, their values are greater than zero.

Stationary Test Results

The data set in time series nature is tested for stationary through the Augmented Dickey-Fuller, Phillip Perron and KPSS tests; the result is indicated in Table II. At level, none of the series were stationary with ADF and PP, taking the first difference of all the series, the result showed that the time series is stationary, with the ADF and PP statistic being significant at the 1% level at the first difference which is confirmed by the KPSS test of showing significance at 99% confident level at level. With the evidence that, the four variables are integrated of order one i.e I (1) – they are stationary for KPSS at level and first difference for ADF and PP tests, there is the need to continue to test for multivariate cointegration using Johansen (1988) cointegration test for the non-stationary pair variables.

Table II Results of Unit root test of variables (ADF, PP and KPSS test)

Variables	Level			First Difference		
	ADF Test	PP Test	KPSS Test	ADF Test	PP Test	KPSS Test
IR	3.3463	3.8974	1.6289***	7.2584***	7.0232***	0.0658
PD	3.4536	3.4856	2.8374***	6.4374***	7.2353***	0.0843
NER	2.0334	2.4654	1.4004***	5.4263***	5.3724***	0.1754
M2	1.938	2.0115	2.3643***	5.1283***	5.9334***	0.0644

NB: *** 1% and ** 5% critical values for both the ADF and PP test are -5.036 and -4.448 while the KPSS test has ***1%, **5% and *10% critical values of 0.849, 0.767 and 0.563 respectively.

Source: Authors` computation, 2017

Table III Correlation matrix for variables in the model

Variables	IR	PD	NER	M2
IR	1.00000	0.74982	0.32273	0.80243
PD	0.74982	1.00000	0.38664	0.58068
NER	0.32273	0.38664	1.00000	0.32215
M2	0.80243	0.58068	0.32215	1.00000

Source: Authors` computation, 2017

Table IV Results of Johansen test of Cointegration (Trace and Eigenvalue test statistic)

Variables	Trace Stat.	5% Critical Value	Eigen Value	Max-Eigen Value Stat.	5% Critical Value
None	20.8433**	19.8552	0.8556	17.8561**	17.7458
At most 1	17.0653	17.3846	0.7453	14.9657	15.3653
At most 2	14.7649	15.6629	0.6359	13.6083	14.9543
At most 3	12.3575	14.6392	0.5375	11.5635	13.1483

Source: Authors` computation, 2017

*Note: The asterisks **indicate rejection of the null hypothesis of no cointegration at the 5%.*

Table V Results of Granger causality

Variables	Granger Causality		
	T- Stats.	P. value	Decision
$IR \rightarrow PD$	3.9538	0.4789	No causality
$PD \rightarrow IR$	2.3641	0.0471*	causality

Source: Authors` computation, 2017

Table VI Results of Fully Modified OLS

Variables	Coefficients (Elasticity)	Standard Error	t-statistic	Probability
Cons	-2.8465	0.7521	-5.56	0.148
PD	0.5863	0.0625	4.09	0.002***
NER	0.2189	0.7298	2.37	0.114
M2	0.0475	0.1173	1.43	0.064*
*Note: Dependent variable is International reserves and ***P=0.01; **P=0.05; *P=0.1*				

Source: Authors' computation, 2017

Correlation Matrix

Before co-integration analysis, which deals with long run relation between variables, the study finds it important to determine the degree of relationship that exists between each two pair of the variables. Matrix of correlation measures the level of association between two random variables of a data set involving dependence. The degree of linkage is measured by computing the correlation coefficients of row*i*and column*j*matrix in which the diagonal figures must be 1 equivalent. Correlation coefficient matrix value range from -1 to +1 inclusive in which the absolute value determines the strength linkage of the two variables and the sign (positive or negative) shows direction of linear relationship between two variables. The closer the value to one, either positive or negative, indicates the stronger relationship that exists between the variables. The correlation matrix coefficients of the various variables are presented in Table III. The results indicate that there is a positive correlation between the pair of variables and also, the short term association between international reserves and broad money supply is the strongest, while the short term relationship between international reserves and nominal effective exchange rate is the weakest among all the variables pair.

Co-integration for Series

This study determines the long run relationship among the variables by combining the Trace and Eigen value tests, though, some research shows that, the power of the two tests are very similar. A Monte Carlo comparison shows, however, that there may be slight differences in small sample size. It is critical to combine the two methods in that; trace tests tend to have more distorted sizes where as their power are in some

situations superior to that of the maximum eigenvalue tests. The results of Johansen cointegration using Stata 11.0 are presented in Table IV.

From Table III, the trace statistic with a statistic value of 20.8433 is greater than 5% critical value 19.8543. Therefore, the research rejects the null hypothesis of no cointegrating equation and confirmed the research or alternate hypothesis of cointegrating equations. However, the research could not reject the null hypothesis of "at most 1" as the statistic value is less than 95% confident critic value. Hence, it is concluded that the model consists of one cointegrated equation using the Trace test.

A way to confirm the Trace results is to check for the presence of cointegration using Unrestricted Cointegration Rank Test – Maximum Eigen value test. In this test, the Max-Eigen statistic has a value of 17.8561 is greater than the 0.05 critical value (17.7458). This implies, the null hypothesis of no cointegrating equations is obviously not true and hence rejected, and the alternate hypothesis of the presence of cointegration again could not be rejected. Both the restricted and unrestricted test simply illustrate that, there is a long run association or relationship among the four macro-economic variables in Ghana`s economy considering the data for the period of the analysis.

Results for Granger Causality

The causality results in Table V indicate that, the null hypothesis of no Granger causality of international or external reserves to public debt (government external borrowing) could not be rejected. In that, when the test statistic of 3.9538 probability value of 0.4789 is compared to the critical value corresponding to a 5% level of significance, the probability value for the test statistic is great. On the contrary, the null hypothesis causal decision for public debt to external reserve was rejected on the bases that, the Probability value is less than 0.05 showing that the test value is greater than the respective critical value not shown in the table

Fully Modified OLS Results

The fully modified OLS (FMOLS) was employed to evaluate the long run impact level of the independent variables (public debt, broad money supply and nominal effective exchange rate) on the dependent variable (International or external reserves) since Johansen cointegration test confirms the presence of long run association of the variables under consideration. From the FMOLS results in Table VI, the adjusted $R^2$of 0.7624 indicates that the independent variables (public debt, nominal exchange rate, and broad money supply) in the model jointly explain 76.24 percent of the variations in the dependent variable (external reserve) whereas other variables not captured, usually called omitted variables in the FMOLS account for the remaining 23.76 percent fluctuations in the dependent variable.

Among the three explanatory variables, only the probability value for public debt reveals to be statistically significant at 1 percent significant level. This confirms the results of the correlation matrix and the Granger causality which state that, there is a strong relationship between international reserve and public debt and that, public debt granger causes external reserves to change. Also, broad money supply was significant at 10% significant level. However, normal exchange rate which again in the correlation matrix has a weak association is insignificant even at 90% confident level. By implication, 1 percent increase in public debt could induce 0.5863 percent increase in external debt in the long run. This means that, when there is increase in government of Ghana's total debt stock, holding other factors constant, there is the tendency that external reserve that serves as a national collateral security will be raised to open a better chance for more borrowing. However, this behaviour can bring serious difficulties in evaluating reserve adequacy since increasing debt could raise the uncertainty in external reserve fluctuation.

Also, 1 percent increase in broad money supply could influence external reserve to positively change in the long run by 0.0475. The research least expected broad money supply to have influence on the external reserves of Ghana. This is due to the fact that, broad money supply which is an indicator of resident capital flight does not Granger-cause change in external reserve as observed in macroeconomics, but the FMOLS results indicates inconsistent outcome which is in line with (Senibi et al., 2016 and Olatunji and Oloye, 2015).

CONCLUSION AND RECOMMENDATION

From the analysis, it is empirically evident that, Ghana's public debt and broad money supply have both short and long run but positive and considerable influence on international reserves (external reserve) while nominal exchange rate has a weak linkage and at the same time is insignificantly related to Ghana`s external reserves. This research does not only indicate the extent to which Ghana's outstanding public debt reflects on the economy's external reserve, but also, the reason behind debts rescheduling by the external lending institution particularly from the time of the economic crises – between 1982 to 1986 and also from 2013 to 2015. It is a fact that, aside external reserve linkage to international or public debts or borrowing, other factors such as rapid accumulation of trade arrears for previous years due to the issue of debt resulted from fall in primary products like cocoa, timber, gold among other prices has contributed to Ghana's overwhelming debt situation. Also, the 1981 world market price crises have affected the debt crisis of Ghana as an exogenous factor. This was complemented by the swindling of foreign exchange receipt and endogenous factors such as the nature of the economy, economic policies and high government expenditure on unproductive ventures.

Critical thinking based on major findings of this study shows that, policies in Ghana that gears toward the control of government borrowing should lay down healthy guideline for public loans, outlining the purpose or reason for borrowing the money and time frame of repayment not in relation to re-borrowing, but in linkage to investment benefit accrual. The research also recommends that, external reserves should not be an indicator of borrowing as perceived by many developing countries' governments, but borrowing should work in the principle of necessities, commitments of the managers and good negotiation fees in which the administration can admit and guarantee loans particularly for external debt. Borrowed funds from external sources must not be channeled towards projects with low or no returns such as war goods. Economic policies should also be directed towards export led promotion and import substitution industries to increase the value of the primary product Ghana exports, as this would increase the level of trade balance and economic activities thereby resulting in an improvement in external reserve.

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